

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,350,499 B2
APPLICATION NO. : 10/573788
DATED : April 1, 2008
INVENTOR(S) : Toshifumi Takaoka et al.

3
Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Delete the title page and substitute therefor the attached title page.

Column 8, line 42 - Column 10, line 4,
Replace claims 1-6 with the following claims 1-5:

1. A control device for cylinder reducing operation in which at least one of cylinders of a multi-cylinder internal combustion engine are selectively inactivated, comprising a detector detecting engine output torque and judging if the cylinder reducing operation is to be executed while referring to the engine output torque detected with the detector; wherein criteria of the judgment of the execution of the cylinder reducing operation are modified through a learning process in which, when an engine is operated in the reduced cylinder mode, an output torque at a certain engine revolution and at a predetermined upper limit of throttle angle is set to the upper limit of engine output torque at the certain engine revolution for the judgment of the execution of the reduced cylinder operation.

2. A device according to claim 1, wherein the judgment of the execution of the cylinder reducing operation based upon the engine output torque is performed by setting out a two-dimensional map of engine revolution and the engine output torque, which map is divided into a normal operation region and a reduced cylinder operation region; and judging which of the normal operation region and the reduced cylinder operation region an engine operation condition is fallen into.

3. A device according to claim 2, wherein the map is modified depending upon engine operating environments.

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,350,499 B2
APPLICATION NO. : 10/573788
DATED : April 1, 2008
INVENTOR(S) : Toshifumi Takaoka et al.

3
Page 2 of 4

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

4. A device according to claim 1, wherein an output shaft of the multi-cylinder engine is operationally linked to an electric motor and an electric generator through a planetary gear and an axle of the planetary gear linked to the motor drives wheels, and the detector detecting engine output torque is the generator.

5. A device according to claim 4, wherein a variation of the output torque from the engine due to a variation of an inertial mass of motion in the engine is compensated based upon the detection of the output torque.

This certificate supersedes certificate of correction
issued March 10, 2009.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



US007350499B2

(12) **United States Patent**
Takaoka et al.

(10) Patent No.: **US 7,350,499 B2**
(45) Date of Patent: **Apr. 1, 2008**

(54) **CONTROL DEVICE OF CYLINDER
REDUCING OPERATION OF
MULTI-CYLINDER ENGINE**

(75) Inventors: **Toshifumi Takaoka, Susono (JP);
Tadashi Akiyama, Susono (JP);
Takashi Suzuki, Gotenba (JP); Toshio
Inoue, Gotenba (JP)**

(73) Assignee: **Toyota Jidosha Kabushiki Kaisha,
Toyota (JP)**

(*) Notice: **Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 199 days.**

(21) Appl. No.: **10/573,788**

(22) PCT Filed: **Nov. 5, 2004**

(86) PCT No.: **PCT/JP2004/016793**

§ 371 (c)(1),
(2), (4) Date: **Mar. 28, 2006**

(87) PCT Pub. No.: **WO2005/045217**

PCT Pub. Date: **May 19, 2005**

(65) **Prior Publication Data**

US 2007/0042861 A1 Feb. 22, 2007

(30) **Foreign Application Priority Data**

Nov. 7, 2003 (JP) 2003-378036

(51) Int. Cl.
F02D 13/06 (2006.01)

(52) U.S. Cl. 123/198 F

(58) Field of Classification Search 123/198 F
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,481,461 A 1/1996 Miyamoto et al.

5,496,229 A 3/1996 Miyamoto
5,884,603 A 3/1999 Matsuki
6,244,242 B1 6/2001 Grizzle et al.
6,651,619 B2 * 11/2003 Ogiso 123/90.15
2001/0013330 A1 8/2001 Grizzle et al.
2002/0162540 A1 11/2002 Matthews et al.

FOREIGN PATENT DOCUMENTS

DE	33 34 720 A1	4/1985
DE	196 04 737 A1	8/1997
JP	A 05-272367	10/1993
JP	A 05-332172	12/1993
JP	A 06-193478	7/1994
JP	A 07-180575	7/1995
JP	A 10-103097	4/1998
JP	A 10-103124	4/1998
JP	A 11-182275	7/1999
JP	A 11-350995	12/1999
JP	A 2000-92613	3/2000
JP	A 2001-164960	6/2001

* cited by examiner

Primary Examiner—Noah P. Kamen

(74) Attorney, Agent, or Firm—Oliff & Berridge, PLC

(57) **ABSTRACT**

A control device for cylinder reducing operation of a multi-cylinder engine for a vehicle controls the number of working cylinders in the engine more appropriately for fuel economy while ensuring the operational stability of the engine and comfortable drivability of the vehicle. The control device comprises a detector detecting engine output torque and judges if cylinder reducing operation is to be executed while referring to the engine output torque. Because of the detection of engine output torque, cylinder reducing operation will be executed as long as torque requested of the engine is available from the reduced number of working cylinders, thereby ensuring the generation of torque required in operating the engine while saving fuel as much as possible. Through a learning process, criteria for the judgment of execution of cylinder reducing operation are modified to be adapted for any variation of engine output performances.

5 Claims, 3 Drawing Sheets

